AD-A192 950 A FUNDAMENTAL STUDY OF P/M PROCESSED ELEVATED TEMPERATURE ALUMINUM ALLOYS(U) DREXEL UNIV PHILADELPHIA PA DEPT OF MATERIALS ENGINEERING M KOCZAK 31 DEC 87 AFOSR-TR-88-0305 AFOSR-87-0012 F/G 11/6 NL

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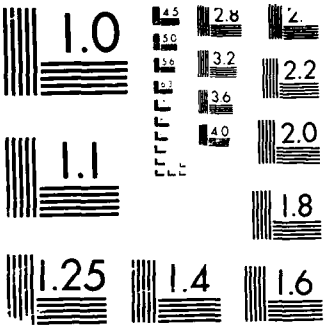

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: Unclassified	1b. RESTRICTIVE MARKINGS
DTIC ELECTE MAR 30 1988 D	3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for Public release distribution unlimited
AD-A192 958	5. MONITORING ORGANIZATION REPORT NUMBER(S): AFOSR-TR- 88-0205
6a. NAME OF PERFORMING ORGANIZATION: Drexel University; 6b. OFFICE SYMBOL (If applicable):	7a. NAME OF MONITORING ORGANIZATION: AFOSR
6c. ADDRESS (City, State and ZIP Code): 32nd & Chestnut Streets, Philadelphia, PA 19104	7b. ADDRESS (City, State and ZIP Code): AFOSR/NE, Building 410, Bolling AFB, DC 20332-6448
8a. NAME OF FUNDING/SPONSORING ORGANIZATION: AFOSR; 8b. OFFICE SYMBOL (If applicable): NE	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: AFOSR-87-0012
8c. ADDRESS (City, State and ZIP Code): AFOSR/NE, Building 410, Bolling AFB, DC 20332-6448	10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.
61102F	2917	A3	

11. TITLE (Include Security Classification): A Fundamental Study of P/M Processed Elevated Temperature Aluminum Alloys

12. PERSONAL AUTHOR(S): Koczak, Michael

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Yr., Mo., Day)	15. PAGE COUNT
Final	FROM 10/86 TO 12/87	12/31/87	3

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A key ingredient in the development of high performance composite and powder processed RST materials is the understanding of the processing/structure/property relationship. A vital part of this understanding is the independent control of material chemistry and processing coupled with the ability to excercise careful control of the temperature-time-pressure relationships during the consolidation of composite and powder processed structures. To this end, an equipment grant, requested for a high temperature Vacuum Industries vacuum hot press for the fabrication of metal and ceramic matrix composites as well as a Lipton/MT composite curing autoclave/press for the consolidation of resin matrix and hybrid composite systems. A salient feature is the capability to produce composite and powder processed samples of sufficient dimensions so that meaningful mechanical and structural evaluations can be performed. The combined systems, i.e. vacuum hot press, autoclave and laminating press, shall provide the research faculty with this state of the art capability for the processing advanced resin, ceramic and metal matrix composite structures as well as supporting on-going programs in rapid solidification technology and ceramics.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS ☐	Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE NUMBER (Include Area Code)	22c. OFFICE SYMBOL
		NE

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM
GRANT # AFOSR 87-0012 REPORT

by

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DEPARTMENT OF MATERIALS ENGINEERING

PHILADELPHIA, PA 19104

December 31, 1987

The purpose of the University Research Instrumentation Program is to upgrade university instrumentation and equipment in order to improve their capability to perform research in support of the national interests and defense. Additionally, it should support the ongoing research efforts of the Department of Defense research agencies. The Departments of Materials Engineering and Mechanical Engineering and Mechanics at Drexel University have a strong program in composite materials and materials processing with a proven track record of publications and research. In addition, the Materials Engineering Department has a strong research effort in powder metallurgy and rapid solidification technology (RST). A strong funding base has been established with government, defense and industrial sponsorship. A key ingredient in the development of high performance composite and powder processed RST materials is the understanding of the processing, structure and property relationships. A vital part of this understanding is the independent control of materials chemistry and processing conditions. This capability of process control by the researchers is essential for the improved development of high performance structures and systems. The ability to exercize careful control of the temperature, time, pressure and atmosphere during the consolidation, permits high performance powder metallurgy e.g. Al-Fe-Ce, ceramic structures e.g Si_3N_4 and composite structures to be extended in terms of their quality, capability and performance.

To this end, a University Research Instrumentation Equipment Program (URIP) grant has been utilized to purchase materials processing for high temperature materials and composites consolidation, namely: a Vacuum Industries Series 3600 - hot press for the fabrication of metal and ceramic matrix composites as well as monolithic, isotropic high performance metallic and ceramic materials. The vacuum hot press is necessary for the consolidation of powder metallurgy and composite structures for high performance, high temperature applications. It permits densification of ceramic and metallic structures up to temperatures of 1600 C in vacuum or inert atmospheres with a diameter up to 150 mm (6 in) with a fifty ton pressing capability. In addition, the consolidation atmosphere can be varied as well as the rate of loading. A salient feature is the capacility to produce composite and powder processed samples of sufficient dimensions so that meaningful mechanical and structural evaluations can be performed. For lower temperature composite structures, i.e. thermosetting epoxy, or thermoplastic PEEK, PPS composites and laminated hybrid resin metallic structures e.g. ARALL,: a Lipton Model 1336 Laboratiory Autoclave and a small MT composite laminating press for the consolidation of resin matrix and hybrid composite systems have been acquired. The Lipton Autoclave is anticipated to be operational in January 1988. The contributions from the Drexel's College of Engineering ($20,699) and other research contract contributions ($7,000) were beneficially utilized to facilitate installation and start-up of the equipment, e.g. transformers, utility installation and purchase of carbon-carbon tooling for the instrumentation. In addition, a gift from the Fey family of $80,000 will permit rehabilitation of the powder processing laboratory where the vacuum hot press is currently installed. The resin matrix composite processing equipment, shall be eventually installed in the new Bennett Le Bow Engineering Building with dedicated space for composite processing. The acquisition of the instrumentation will greatly enhance the materials processing and composite materials programs capability of the Materials Engineering and Mechanics Department at Drexel University.

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